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Alaska Village Demonstration Projects

(U.S.) Corvallis Environmental Research Lab, College, AK

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August 1979

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REPORT TO THE CONGRESS

ALASKA VILLAGE DEMONSTRATION PROJECTS

Authorized by
Section 113, Public Law 92-500

July 1, 1973

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16. ABSTRACT

The Alaska Village Demonstration Projects (AVDP) were authorized by Section 113, P.L. 92-500 (86 STAT 816), for the purpose of demonstrating methods to improve sanitary conditions in native villages of Alaska. Central community facilities have been constructed in the native villages of Emmonak and Wainwright to provide a safe water supply; toilets, bathing, and laundry facilities; and sewage and solid waste disposal.

Although there has not been enough time to allow full operation and evaluation of these facilities, it is apparent that the technology is available to provide these basic utility services to the demonstration villages.

A major issue still to be addressed is the lack of clear responsibility for the operation and maintenance of the facilities after the Environmental Protection Agency demonstration program is completed. Adequate local resources to operate the installations are lacking. In the absence of outside financial assistance or without improvements of the local economic base, the operating and maintenance costs of the facilities will increase the villagers' dependence on welfare and may have other undesirable cultural effects. Continued experience with the AVDP is needed to complete evaluation and develop recommendations relation to the establishment of a statewide program.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUL 1 0 1972

OFFICE OF THE
ADMINISTRATOR

Honorable Spiro T. Agnew
President of the Senate
Washington, D. C. 20510

Dear Mr. President:

Pursuant to the "Federal Water Pollution Control Act Amendments of 1972," Section 113, "Alaska Village Demonstration Projects," P.L. 92-500 (86 STAT 816), we respectfully submit this report of our progress toward demonstrating "...methods to provide central community facilities for safe water and elimination or control of pollution in those native villages of Alaska without such facilities."

This report discusses the preliminary results from the two operational central community facilities in the villages of Emmonak and Wainwright. Specific recommendations concerning the most appropriate technology and relating to the establishment of a statewide program are not included in this report because there has not been sufficient time or operating experience to develop such recommendations.

The Environmental Protection Agency is committed to actively pursue the Alaska Village Demonstration Projects program. The preliminary results are encouraging. Public acceptance has been greater than anticipated. The demonstration projects have shown that the technology is available to provide the basic utility services to the villages of Emmonak and Wainwright. Economic considerations concerning construction costs and annual operation and maintenance expenditures must be investigated further.

Continued research and development will provide a sound technical and social-cultural data base upon which an environmentally acceptable statewide program can be developed. It is anticipated that additional projects utilizing technology developed in our program will be implemented by other Federal/State/native village agencies.

Sincerely yours,

Robert W. Fri
Acting Administrator

Enclosure

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUL 10 1973

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ADMINISTRATOR

Honorable Carl Albert
Speaker of the House
of Representatives
Washington, D. C. 20515

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EPA-600/3-79-098
August 1979

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July 1, 1973

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Prepared by the

Office of Research and Development

U. S. Environmental Protection Agency

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Continued experience with the AVDP is needed in order to complete a full evaluation and develop recommendations relating to the establishment of a statewide program.

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SECTION I

CONCLUSIONS

1. The demonstration central community facility at Wainwright, Alaska, (population 330) is being operated by two EPA trained village natives and is providing a safe water supply; toilets, bathing, and laundry; and sewage and solid waste disposal. Comprehensive performance data will be available in July 1974.

2. The demonstration central community facility at Emmonak, Alaska, (population 450) is being operated by two EPA trained village natives and is providing a safe water supply; bathing, and laundry. Operation of the sewage and solid wastes disposal equipment should commence in August 1973. Comprehensive performance data will be available July 1974.

3. The problems associated with the demonstration of this previously untried approach for meeting the environmental health needs of native villages have been more complex than initially envisioned.

4. While the two central community facilities provide the same basic utility services, the design for each central community facility incorporates unique processes and equipment selected to meet applicable water supply, wastewater treatment, and air pollution control standards. Analysis of data collected during the evaluation period will determine whether the standards are being fully and consistently met.

5. The villagers' attitude after several months of use of the central community facility, especially the water supply, bathing, and laundry, has been highly positive.

6. The preliminary design for a third project is being completed in cooperation with the Department of Housing and Urban Development - Modular Integrated Utilities System Program. During Fiscal Year 1974, a native village (population 75-125) will be selected as the location for installation of this third central community facility. Experience with the first two facilities clearly indicates the need for careful scheduling, reliable power supply, comprehensive bid documents, modularized construction, and active involvement of the villagers.

7. Experience with the two existing projects indicates that native manpower is available in the villages to be trained for operation of permanent facilities. Native operators have performed with unusual dedication and have demonstrated sound technical know-how.

8. Pending final audit, the design and construction costs for the Emmonak project were $578,054. Similiar costs for the Wainwright facility were $561,469. The current cost for the design of the Third Project is $60,233. Costs of "production-type" facilities should be less than that of the prototypes. However, inflation must be considered in determining final costs for production facilities.

9. Local financial resources are lacking for support of continued operation after the EPA demonstration is completed. Long term success of any rural utility program must be based upon a more viable support mechanism than the village itself. Clear authority for State and Federal agencies to pool resources and engage in this type of support is not presently available. Lacking such an arrangement, the present installations and any subsequent projects undertaken will pose

a financial burden which the villagers simply cannot be expected to meet with their own resources.

10. Participation by other agencies such as the Public Health Service and the Bureau of Indian Affairs has been significant. Continued cooperation and coordination with the State of Alaska and other Federal agencies as provided by the legislation will assure timely transfer of the latest technology.

11. EPA plans to continue the Alaska Village Demonstration Projects program to assure the timely demonstration and evaluation of both the technology and the economic, political, and cultural impacts of these projects.

12. Specific recommendations "relating to the establishment of a statewide program" are not included in this Report to Congress because there has been insufficient time to firmly determine the most economical, acceptable technology to be applied; and to establish fully the social and economic impact of such facilities on the native communities and on the State of Alaska. The potential environmental impact of implementing a statewide program must also be identified. Sufficient information should be available by July 1975 to fully evaluate the impacts of the demonstration projects, to estimate the capital and operating costs for a statewide program, to consider alternative ways of financing such systems, and to recommend any necessary legislation to Congress.

SECTION II

INTRODUCTION

The "Alaska Village Demonstration Projects (AVDP)" serve to demonstrate methods of improving environmental health conditions in rural Alaska. The need for such improvements is great. Seventy percent of Alaska's natives live in small villages where safe water is seldom obtainable and where adequate waste disposal is often impossible without facilities for special treatment. The average age at death among Alaska natives is half that of other Americans.(1)

Typical sources of drinking water are streams, ponds, or rain during the summer. Many of these ponds and streams are stagnant and contaminated. In areas underlain by permafrost, wells are generally unproductive. During the winter, villagers cut ice and melt it in discarded fuel drums at home.

Simple methods of waste disposal are often not possible because of unfavorable terrain and soil conditions (Fig. 1). Many villages are subject to annual flooding. Wastes from latrines and dumps re-emerges during flood periods and is spread throughout the town. Communities along the Arctic Ocean store wastes from "honey buckets" in empty drums some distance from the home (Fig. 2). In early spring, the frozen drums are hauled out onto the ocean ice for disposal. During the short summer the stench can be annoying and pervasive. The health hazard associated with this practice is serious.

The difficulties of arriving at satisfactory, practical solutions to water supply and waste disposal problems in such locations are

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FIG-1 Solid Wastes Disposal in Emmonak - Attempts at disposal by burial in pits have been frustrated by the high ground water level and instability of the silty soil.

FIG-2 Human waste disposal in Wainwright - Discarded fuel drums are used to store human wastes from chamber pots and "honey buckets". In mid-winter, the frozen drums are hauled out into the ocean ice for final disposal.

as great as the need. Successful application of many conventional approaches is ruled out by high costs or the severe climate. Water is in the frozen state most of the year. The processes by which wastes naturally tend to decompose are interrupted and seriously retarded by the long winters. The cold also tends to preserve pathogens for longer periods than under normal weather conditions. These considerations substantially increase associated health hazards. Basic health and environmental standards can be achieved only through new service concepts such as reuse of water and through application of unconventional technology.

Resources to provide this technology do not exist in the villages. On the average, more than half of the workforce is jobless most of the year. For them, food gathering activities provide basic subsistence. Only one-fourth of the workforce has continuing employment.(2)

These, then, are some of the pressing problems which stimulated legislation in 1970 which called upon the Secretary of the Interior (now the Administrator of EPA) to conceive, construct, and install prototype facilities which demonstrate methods of providing basic utility services in Alaska native villages. The text of Section 113 of P.L. 92-500 follows:

"ALASKA VILLAGE DEMONSTRATION PROJECTS"

"Sec. 113. (a) The Administrator is authorized to enter into agreements with the State of Alaska to carry out one or more projects to demonstrate methods to provide for central community facilities for safe water and control of pollution in those

native villages of Alaska without such facilities. Such projects shall include provisions for community safe water supply systems, toilets, bathing and laundry facilities, sewage disposal facilities, and other similar facilities, and educational and informational facilities and programs relating to health and hygiene. Such demonstration projects shall be for the further purpose of developing preliminary plans for providing such safe water and such elimination or control of pollution for all native villages in such State.

"(b) In carrying out this section the Administrator shall cooperate with the Secretary of Health, Education, and Welfare for the purpose of utilizing such of the personnel and facilities of that Department as may be appropriate.

"(c) The Administrator shall report to Congress not later than July 1, 1973, the results of the demonstration projects authorized by this section together with his recommendations, including any necessary legislation, relating to the establishment of a statewide program.

"(d) There is authorized to be appropriated not to exceed $2,000,000 to carry out this section."

P.L. 92-500 (86STAT. 833)

Two such installations are now near completion. A design for a third facility which incorporates the Modular Integrated Utility System developed by HUD has been initiated. This report describes what has been accomplished and enumerates some initial conclusions and recommendations.

SECTION III

PROJECT IMPLEMENTATION

Project Staff

The EPA elected to begin the AVDP project with a minimal staff, since there was no fixed idea as to the scope of the demonstration project. A project head was selected ~~that~~ who had years of experience in public health work and basic sanitation in cold climates. A project advisor with several years' experience in community development work in underdeveloped countries was recruited to help bridge the gap between the government program, its technology and procedure, and the understanding and participation of the native village residents. A career sanitary engineer with experience in research work and willing to work in remote Alaska was assigned to the staff. A clerk-stenographer was added to the staff to fulfill the clerical needs. In 1972, a trained and experienced treatment plant operator joined the staff to provide on-the-job training for the village facility operators. The duty station of this group is at the Arctic Environmental Research Laboratory, formerly known as the Alaska Water Laboratory in College, Alaska.

Legislative Intent

The text of Section 113 P.L. 92-500, the Federal Water Pollution Act Amendments of 1972, is brief. To obtain further guidance towards implementation, the staff examined Senate and House hearing records and visited with authors of the amendments.

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It should be noted that the legislation intended that no facilities were to be installed in the homes. Thus, it follows that no distribution or collection system of pipes should be installed to serve individual homes.

Senator Ted Stevens of Alaska initially expressed hope that five facilities could be constructed with the initial $1,000,000 appropriation, each demonstrating a different approach to pollution control. After a cursory examination of costs, it was apparent that minimal service and pollution control standards could not be met in the typical village with a $200,000 investment. A projected cost figure of $300,000 per facility was then established.

Other guidelines gained from efforts to ascertain legislative intent suggested that project locations should be in North and West Alaska, preferably where health problems were most severe; that facilities should be constructed as soon as possible: and that the installations should be of somewhat temporary or relocatable nature rather than permanent public works.

The AVDP program was intended as an initial effort to demonstrate technical and economic feasibility for central community facilities. Successful results would lead to the establishment of a statewide plan to provide for safe water and control of pollution in these native villages of Alaska without such facilities.

Site Selection

Early planning required careful consideration of each village's characteristics, such as location and climate, social and economic viability, water supply, health problems, etc. The task of

providing safe water and adequate waste disposal is accomplished more easily in some native villages than in others.

The majority of the native village population lives in those areas of Alaska where geology and climate combine to make provision of basic utility services especially difficult and expensive. It was decided that sites would be selected from each of these three regions: (Fig. 3).

1. The Kuskokwim Region, with 52 of the 178 predominantly native communities in Alaska and 31% of the rural native population.
2. Northwest Alaska, with 28% of the Alaskan rural natives in 35 villages, and
3. Interior Alaska, with 11% of the rural natives distributed among 28 predominantly native communities.(3)

The distribution of Alaska natives by size of place is listed below:

DISTRIBUTION OF ALASKA NATIVES BY SIZE OF PLACE IN PREDOMINANTLY NATIVE PLACES, 1967

Total Size of Place	No. of Places	Native Population	Cumulative Totals No. of Places	Native Population
25-99	50	2,839	50	2,839
100-199	64	8,813	114	11,652
200-299	26	5,735	140	17,387
300-399	15	4,357	155	21,744
400-499	12	4,807	167	26,551
500-599	2	1,021	169	27,572
600-699	2	1,113	171	28,685
700-799	-	-	171	28,685
800-899	1	825	172	29,510
900-999	-	-	172	29,510
1000-2499	6	7,888	178	37,398

Source: Villages in Alaska and Other Places Having a Native Population of 25 or more, a report prepared by the Federal Field Committee for Development Planning in Alaska, Anchorage, Alaska, 1967.

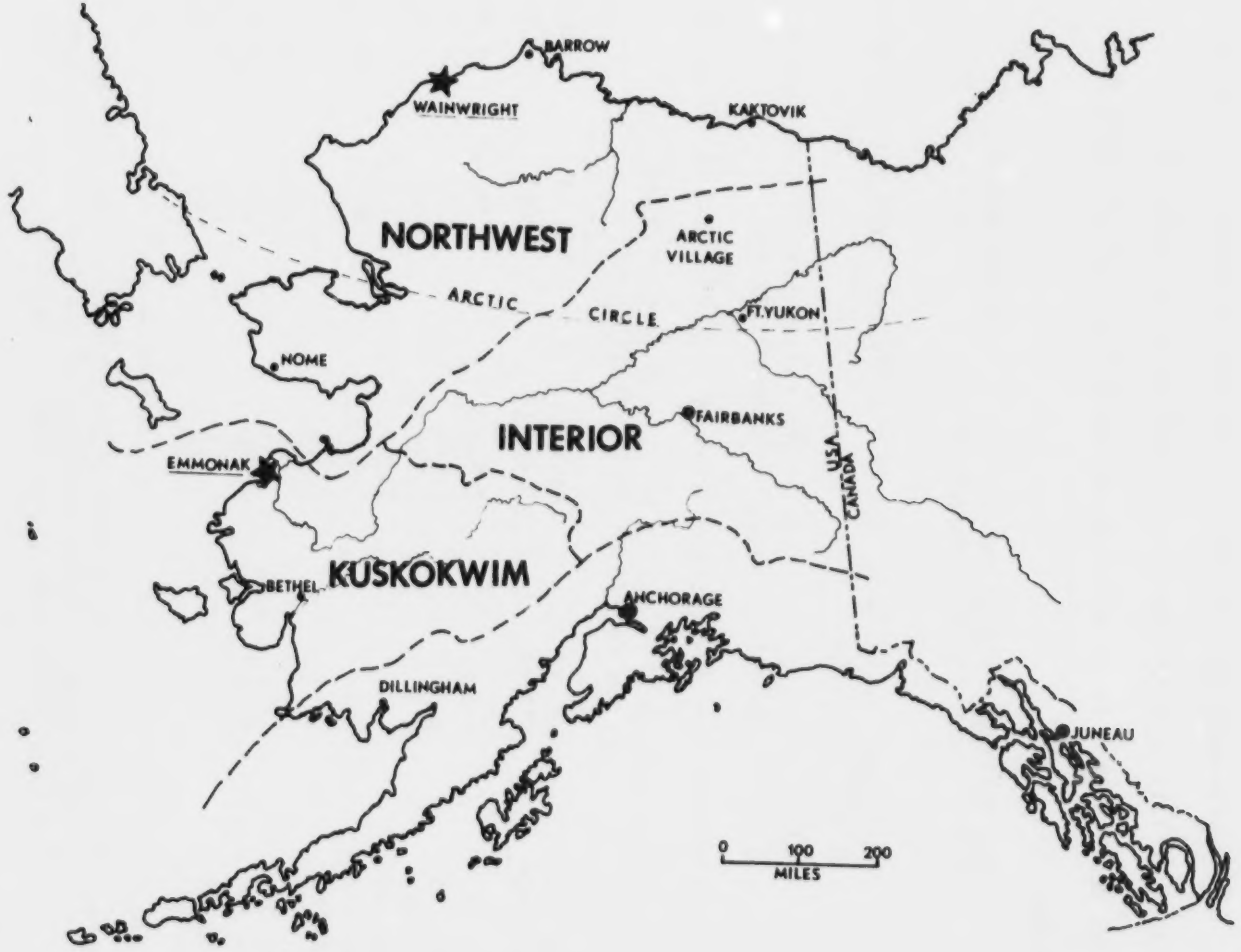


FIG-3 Alaska Village Demonstration Project Locations

FIG-4 Village of Wainwright - The winter picture is taken from the present location of the Central Community Facility. In the background is the Arctic Ocean.

FIG-5 Village of Emmonak - The Central Community Facility is the white building near the center of the picture. The water intake and discharge utiliduct extends to the Kwiguk Pass of the Yukon River on the left. The large complex of building between the AVDP plant and the river is the BIA school. Along the horizon is the Bering Sea.

Aside from the above considerations, the degree of regional and local interest in the project was judged the most important single criterion for final selection. In the case of the Kuskokwim and Northwest Areas, the Associated Village Council Presidents and the Arctic Slope Native Association were consulted. They responded enthusiastically to requests for assistance in determining candidate communities within their regions. The president of the Arctic Slope Native Association participated as a member of an advisory group to the project under auspices of the National Academy of Sciences. The advisory group prepared a report summarizing considerations for project implementation.(4) In the Kuskokwim Region, the Associated Village Council Presidents, Inc. met to propose five communities for consideration.

Wainwright, an Eskimo village of 330, was selected from the Northwest Region (Fig. 4). It is situated on treeless tundra, along the Arctic Ocean, 80 miles southwest of Point Barrow. Here truly arctic conditions prevail.

The village of Emmonak, located in the Yukon Delta, was chosen from the Kuskokwim Region (Fig. 5). Emmonak is a relatively large community (pop. 450) of Eskimo salmon fishermen among whom water related intestinal disorders have been especially common. Located only a few miles from the Bering Sea, on low delta ground, the village experiences frequent flooding caused by ice jams near the mouth of the Yukon River during spring breakup. A third site is being considered in the Interior Region, but has not yet been selected.

The final choice of the first two sites was influenced by information on water and sewage related health problems in these communities; by the degree of locally-expressed need; and by assessments of village leadership, social stability, economic viability; and experience of the communities with similar innovative ventures.

Members of the VISTA project, the Rural Community Action Program, the Community Enterprise Development Corporation and Alaska Legal Services greatly assisted with information in compiling village profiles.

Throughout the process of selection, Federal and State agencies which were concerned, were extensively consulted. An ad hoc working group was formed to assure compatibility of the demonstration project with the plans of those agencies who retain primary responsibility for the development and maintenance of utility services in rural Alaska. Representatives from the Alaska Area Native Health Service, Department of Health, Education and Welfare; the Alaska Department of Health and Welfare (now the Department of Environmental Conservation); the Department of Health and Social Services; the Governor's Office; the Economic Development Administration; and the Bureau of Indian Affairs participated in this group.

Historical Considerations

Over the years, a number of government programs have attempted to improve basic sanitation in rural Alaska. At best, these have been only partially successful. In developing a sensible approach to implementing the AVDP, an attempt was made to determine the reasons for lack of success of other programs.

Administrative constraints, including a lack of financial resources for operation and maintenance of completed facilities, have generally been the limiting factors. Some of the most important of these specific factors are as follows:

1. Administrative policy limitations such as required participation by recipient; dilution in effort by being included in a nationwide program; conducting the entire effort without understanding and responding to local needs and wishes; and in appropriate design concepts transplanted from temperate climates.
2. Preconceived notions of the level of funding or limitations on the cost or size of projects has usually resulted in program failure.
3. Government budgeting and programming schedules have adversely affected the performance and goals of many projects.
4. A high turnover of personnel in Alaska has had the effect of continuing many programs with personnel inexperienced in Arctic environmental engineering or for working successfully with Alaska villagers.
5. Lack of viable on-going programs to assure continuity in operating and maintaining village utilities was perhaps the most significant reason for many projects failing to live up to expectations. Villagers do not have fiscal resources to support such operations, nor have they had appropriate training.

It was apparent that development of new concepts was needed in implementing AVDP. This was accomplished through discussions which

resulted in contributions from villagers themselves. The actual needs seemed to lie somewhere between the squalor in which many villages existed and the typical American communities in which running water and flush toilets have become minimum standards.

Conceptual Design

The AVDP staff surveyed what work had already been done in reference to village utilities by other Federal and State agencies, compiled village profiles, and researched the State-of-the-Art in cold regions water treatment and waste disposal. It was established that Federal and State environmental and health standards would be met. General design concepts and processes to meet these standards were then selected.

The application of conventional collection, distribution and treatment technology would have required investments of enormous capital in villages whose future is uncertain. Arctic and subarctic experience has shown that conventional systems which provide piped water to homes and rely upon water carried sewage are not only expensive to construct, but are also highly susceptible to failure. Seldom do such utility networks reach all homes of the village.

The conceptual design explored previously untried approaches to meeting environmental health needs of small Alaskan communities.

As an alternative to the conventional design, a central community facility was considered where people would perform some of the functions which are normally done at home (Fig. 6). By having residents do their laundering and bathing at a central location and through use of low-or-no-water-use toilets at home, total volumes of water required by a community can be drastically reduced. The amount of water needed in the

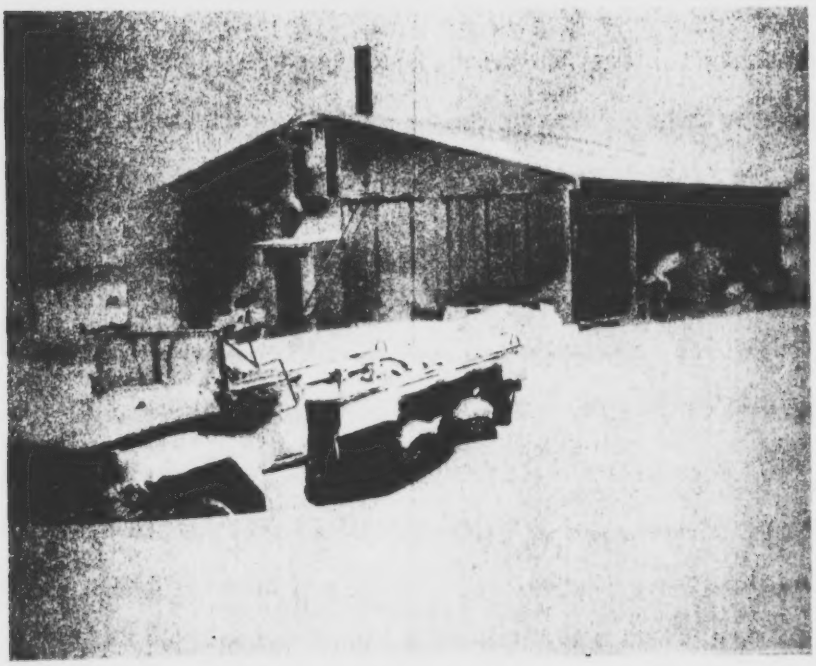


FIG-6 Central Community Facility, Wainwright.

FIG-7 Washers and dryers in Emmonak - They are in high demand at both Wainwright and Emmonak.

home would be small enough to be individually carried or distributed by vehicles. Washing machines, dryers, bathtubs, or showers would not need to be duplicated from home to home where they would compete for precious space (Fig. 7).

Waste disposal, which conventionally involves an initial process of separating pollutants from water, would be simplified. Human wastes would not be diluted with water and could, therefore, be subjected directly to final disposal.

Incineration was selected as one of the processes of the system with full knowledge that it is generally considered an extravagant use of energy. Alternatives to incineration were water carried sewage systems and sewage lagoons or another biological treatment system. However, these systems also lead to large scale sludge disposal problems. Even if sludge from the wastewater was easily disposed of, the problem of household refuse disposal would remain.

By concentrating all utility functions at one location, incineration could economically be incorporated. Through application of heat exchangers, the incinerator could serve as main source of heat for the entire complex. Thus, energy which normally goes to waste would be conserved.

Conservation of water was also an important objective. Currently, water used for drinking in the villages may be 30 to 50 times as expensive as it is in the lower 48 states. Therefore, it was essential to find ways of minimizing water consumption within the facilities. Hot air was found to be far cheaper than hot water and, therefore, saunas were specified for bathing purposes. At

locations where water supplies were finite, such as at Wainwright for eight months of the year, reuse of treated water was explored.

As previously mentioned, the legislative intent was that no distribution and collection mains would be installed. On the basis of previous experience and feedback from the native communities, it was determined that a vehicular waste collection system would be essential and that water distribution wagons would enhance the viability of the project (Fig. 8). Without some type of centrally controlled waste collection and water distribution, the central community facility concept could not be expected to work.

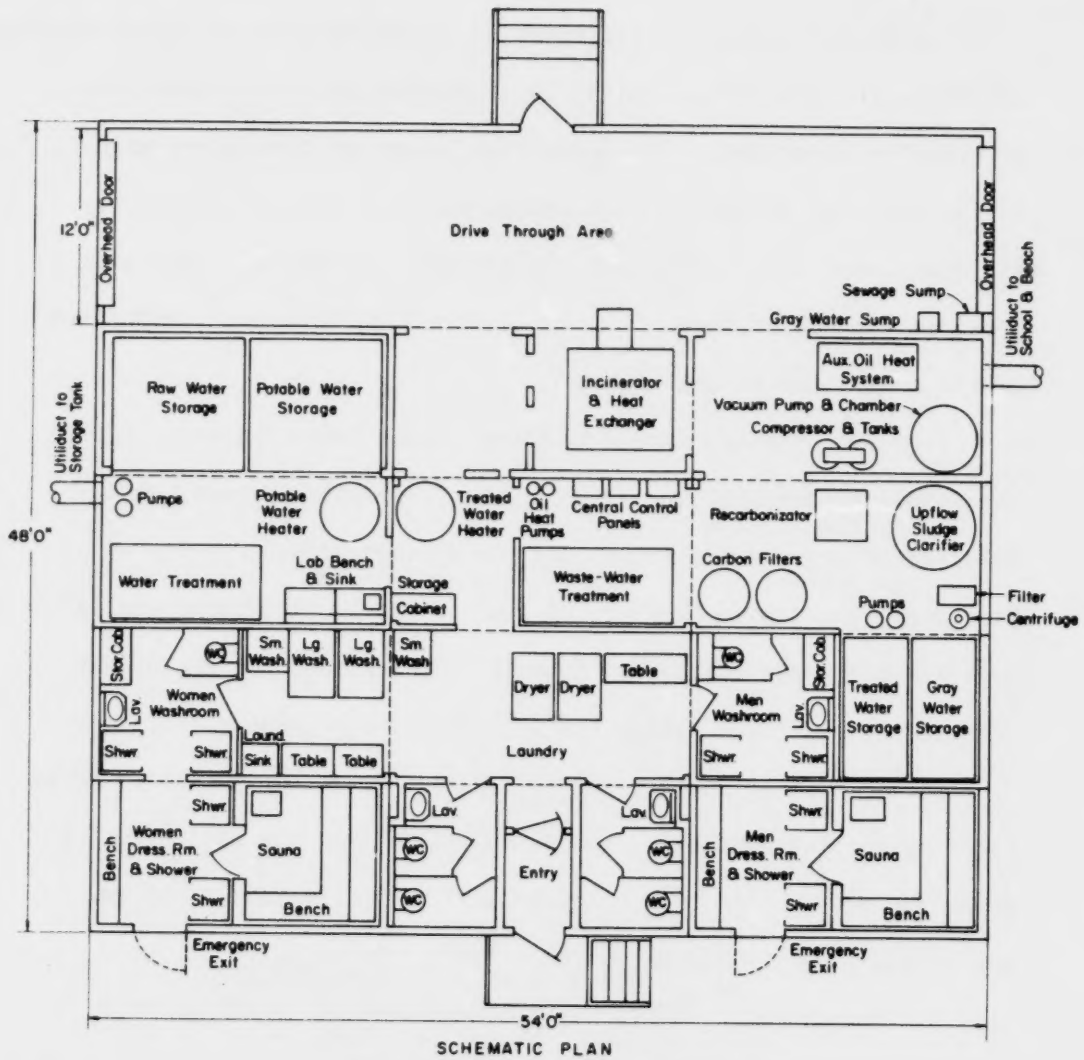
In accordance with established procedures, the Agency published a request for proposals for the conceptual design, construction and installation of the required facilities.

FIG-8 Improvised water delivery system - Most significant, from the villagers' point of view, are the AVDP facilities as a source of safe water. During a breakdown of the water distribution vehicle, here Emmonak villagers are improvising to get water to their homes.

The design guidelines incorporated in the request for qualifications and proposals were intentionally kept broad to encourage submission of creative approaches. The guidelines addressed themselves mainly to the need for reliability of components, high thermal efficiency, and compliance with health and environmental standards. They also provided a scope of services to be provided and a general description of the conditions in the villages.

From over twenty responding firms, three companies were finally selected for negotiation. Wasteco, Inc., Tualatin, Oregon, was selected to provide facilities for the Village of Wainwright. Bionomics, Inc., West Chester, Pa., was selected to provide similar facilities for the village of Emmonak. Stefano and Associates was selected to provide a design for a third village project.

Although final designs for the initial two facilities were formulated by the two companies without collaboration, the basic requirements for pre-manufacture, transportability by aircraft or barge, and suitability for relocation at a later time resulted in two very similar projects. They consisted of an integrated system of unit processes for water and wastewater treatment, solid waste incineration, and conventional bath and laundry equipment housed in truck van sized modules which could be transported to the site as multiple-use shipping containers (Fig. 9).



SCHEMATIC PLAN

FIG-9 Floor Plan for Central Community Facility-Emmonak

Contractual Arrangements & Project Development

The Agency's research and development contract mechanism was considered appropriate for carrying out the requirements of the Act. This method of contracting allowed the Agency to review concepts proposed by any interested party, select those appropriate and then contract for the work. It also allowed for the facilities to be designed, developed, and installed without requiring detailed specifications and descriptions as a part of the contract.

The enabling legislation allowed about two and one-half years to complete the project. By the time money had been appropriated and allotted to the project in the field in late 1970, over six months had passed. Determining and arranging for appropriate advertising, negotiating, and in-house contracting procedures consumed approximately four months. Design proposals and statements of qualifications were received by February 1, 1971. After a conference with prospective bidders, at which additional design criteria were discussed, technical and business proposals for facility design and estimated costs for construction were received by mid-March. Design contracts were awarded in May and June 1971.

Designs and initial business proposals for construction and installation were available by mid-summer 1971. These initial business proposals, however, far exceeded target costs. The designs, therefore, were carefully reviewed for possible reductions. It was found that by cutting down on floor space and by rearranging equipment, especially in the public area but also in the mechanical sections, estimated costs were reduced to target levels.

Administrative procedures and program changes delayed contract renegotiations until December 1971. The scope of work and costs for final design, manufacture and installation of both facilities was agreed upon in January 1972. Contracting procedures delayed the actual awarding of contracts until late March and April of 1972.

As a result of these renegotiations and the late awarding of contracts, contractors were hard-pressed to meet annual departure deadlines for boats and barges to Alaska. In addition, there was insufficient time for the facilities to be factory completed and tested to the extent initially envisioned.

Both facilities had to be completed after shipment in sub-zero weather under extremely adverse circumstances (Fig. 10).

FIG-10 Central Community Facility under Construction.

These circumstances resulted in significant increases in costs due to penalties accruing from emergency purchases, shipments, overtime labor, etc.

A valuable lesson has been learned from the construction and initial operation of the two demonstration projects. Any full-scale program to provide similiar facilities in other native villages must recognize the importance of (1) careful scheduling to take full advantage of the short annual construction season, (2) careful preparation of comprehensive statements of work and bid documents, (3) modularized construction techniques to reduce field labor and construction costs, and (4) complete involvement of the village natives in the design, construction, and operation to assure village acceptance.

A proposed time schedule for additional projects must consider a year for design and a year to manufacture, test, and install. In that way, a first class project can be assured and full use be made of the short two to three month construction period in Northern Alaska.

Operator Training

Thorough preparation of local personnel to operate and maintain project facilities was recognized as an essential ingredient of the project from the outset. Because of the small scale and the sophisticated nature of the prototype installations, various standard courses offered for water and sewage works operators were considered inappropriate. Special efforts were made to design a training program of sequence and content which would take into

account the unique background of the Eskimo participants and the unique requirements of the installation. In the process, the basis has been laid for training of additional personnel for similar facilities in the future.

The result of the training effort has been gratifying. Current operating experience has shown that the men selected as operators have performed with unusual dedication and demonstrated sound technical "know-how." They have met a number of serious emergencies, analyzed and corrected the problems, and started up the operation again with only minimal assistance.

Early in 1971, under the guidance of the project advisor, the City Councils each selected and appointed two men for training. In both villages, the team turned out to consist of a manager who was older and had some experience with engines and machinery, and a younger less-experienced assistant. Selection criteria did not call for any specific level of formal education. It did stress evidence of efforts towards self-education, reliability, stability in the management of personal and family affairs, and willingness to stick with the job.

The four men, Donald Redfox and Ambrose Shorty from Emmonak and Charles Nayakik and Larry Bodfish from Wainwright, were made temporary EPA employees with pay received only during periods of training. After one year at WG-1, they were promoted to WG-5.

Manpower Development Training Funds under the Public Service Career Plan in the amount of $17,600 were made available to pay for travel, training supplies, and occasional services of other

than EPA instructors.

To date, training has consisted of an intermittent in-house program of formal instruction, laboratory practice, participation in all aspects of facility construction, and on-the-job training, as follows:

Phase I - Initial Orientation: Two weeks at the Arctic Environmental Research Laboratory in Fairbanks (August 1971).

An intensive course in physical-chemical treatment of water and waste including a review of basic physics, chemistry, arithmetic, and stressing an understanding of sanitation theory (Fig. 11). Laboratory sessions in which water treatment was demonstrated, water quality analyzed, and where trainees practiced process monitoring tests constituted the core of the course. Also,

FIG-11 Plant Operators at Emmonak - Donald Redfox and Ambrose Shorty, Plant Operators Trainees from Emmonak are learning how to perform coliform monitoring tests under the guidance of Dr. Ronald Gordon at the Arctic Environmental Research Laboratory in Fairbanks.

the trainees received instruction and practice in maintenance and repair of machinery and equipment such as washing machines, dryers, pumps, valves, and small engines.

Phase II - Construction and Installation: (April - September 1972).

A two-week review of topics and skills covered during Phase I was followed by full participation of the trainees in the installation of machinery equipment, plumbing, and wiring in the facility modules before they were shipped to the village sites. Depending on construction schedules, these factory visits were of five to ten weeks duration. Spare time was occupied by visits to water and waste treatment plants in the vicinity of the factory; by disassembly and reassembly of machinery components; and review of blueprints, schematics, and operating manuals.

Phase III - On-the-job-Training: (October 1972 - Present).

Systems checkout, trial operation, and on-the-job training was conducted over a six-month period (Fig. 12). Operating instructions were reviewed in detail. Service and maintenance schedules were worked out. Assisted by the project advisor and the village councils, the operators conducted orientation meetings for village residents and provided tours of the plant to encourage appropriate use of the facility. EPA personnel visited each site on a scheduled basis to work with operators on the day-to-day problems they encountered.

Final evaluation of the training program can only come with long-term operation of the plants; however, at this point, all

FIG-12 Emmonak distribution and collection vehicle - Messrs Redfox and Shorty are repairing a Ranger tracked vehicle which is used for water distribution and waste pickup.

indicators are good. The limited formal education of the operators (third grade, in one case) has been of minor consequence. Good image memory skill and an unusual aptitude for improvising appear to have more than compensated for lack of formal education. So far, the men have demonstrated initiative, imagination, and dedication in running the two plants during this initial period of shakedown and winter operation.

Additional training is required and intended. Electric control circuits need more coverage, water treatment chemistry must be better understood, and each operator should eventually be able to pass both the water supply and wastewater treatment plant operator certification examinations.

On the basis of the training experience gained, assistance in village operator training has been requested by the Alaska Department of Environmental Conservation (ADEC). The ADEC is designing a number of facilities similar to the AVDP installations in conjunction with the construction of new village schools. Well-trained men to operate these facilities will be essential.

Villagers are more effectively trained in a village than in an urban setting. Emmonak and Wainwright could well accommodate groups of operator apprentices, with the demonstration plants serving as training cores.

Educational Programs

The legislative Act suggests that educational and informational programs related to health and hygiene be established. Observations made in the course of working with villagers on site selection, design formulation, and in training facility operators indicates that natives are quite health conscious and that they will readily adopt more hygienic ways of doing things when the opportunity is there. Young people have become used to modern standards while away at school or in the service. Older folks have had similar exposure while at hospitals or on visits to Anchorage and Fairbanks. It is apparent that they do understand the need for the kinds of services which the AVDP facilities provide and appreciate them. Working mainly through the plant operators, the Project Advisor and the USPHS Sanitarians will continue to provide pertinent information on health and environmental practices. A more complete program of health education in

relationship to the AVDP facilities will be developed to further enhance the villagers' understanding of the reasons for their application.

Participation of Other Agencies

In previous paragraphs, the cooperation of other agencies has been mentioned. The basic legislation for AVDP provided for cooperation and coordination, by agreement, with the State of Alaska and the U. S. Department of Health, Education and Welfare. These agreements were made, and in the case of HEW, resulted in substantial contribution to the facility at Wainwright by the U. S. Public Health Service, Alaska Area Native Health Service. The Alaska Area Native Health Service offered to participate in the project at Wainwright by constructing a 1,000,000 gallon raw water storage tank at an approximate cost of $300,000 (Fig. 13). The same office

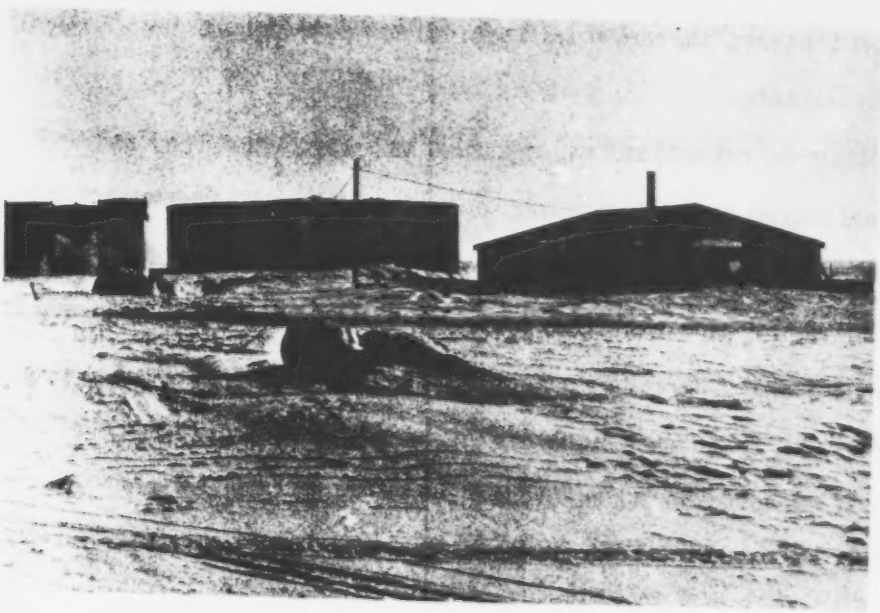


FIG-13 Wainwright Water Supply Storage - 1,000,000 gal. tank provided by the Public Health Service.

is also providing tracked vehicles and necessary equipment for water delivery and waste collection in the village.

By agreement with the Bureau of Indian Affairs, utiliducts will be constructed in Emmonak and Wainwright to provide water and sanitation service to the BIA schools. For the Wainwright plant, BIA has made available a standby 50KW generator.

In order to have some formal planning input from other pertinent state and Federal Government agencies, an ad hoc working committee as previously outlined, was organized. Members of the committee were knowledgeable about village conditions, needs, and regulatory functions. They were also involved in the actual provision of facilities and services in the villages. The participating agencies offered data and expertise in addition to reviewing the AVDP staff work and recommendations. They also reviewed preliminary plans from contractors and provided informal concurrence in the concepts finally selected.

Other organizations and agencies who were consulted and contributed in project planning were the Alaska Federation of Natives, the Associated Village Council Presidents, the State Local Affairs Agency (now the Department of Community and Regional Affairs), the Alaska State Housing Authority, the University of Alaska, the Naval Arctic Research Laboratory at Barrow, the Arctic Health Research Center, the North Slope Native Association, VISTA, RURALCAP, Alaska Legal Services, and the Community Enterprise Development Corporation.

This exercise in interagency consultation led to a fuller recognition of the complexity of coordinating the many programs and projects concerned with Alaska native village. Each project and program affects the other. Jurisdictions, authorities, and mandates are always partial and sometimes these programs overlap. Theoretically, complementary projects often do not meet and leave embarrassing gaps. Administrators and project staffs may have the best intentions of cooperating and they usually do. However, annual appropriation cycles preclude entering into the kind of firm commitments which would be essential to real coordination.

In the final analysis, despite sincere intentions, cooperation usually happens by chance. This stumbling block must be resolved before a successful statewide program can be implemented. In the hope of alleviating these problems, new State/Federal legislation will be investigated during the development of recommendations "relating to the establishment of a statewide program."

SECTION IV

DESCRIPTION OF FACILITIES

Facilities provided at both Emmonak and Wainwright are quite similar. A general description is given here while a more complete description will be available upon submission and approval of the individual contract final report from each contractor.

Modular units, which can be transported by C-130 "Hercules" aircraft, form the structure of the facilities and were placed on foundations appropriate for the location (Fig. 14). The buildings, when completely assembled, provide about 2000 gross square feet of space. About half of this area is used by the public; the rest is utilized for process equipment and tankage. In addition, each facility has an attached drive-through section where vehicles used

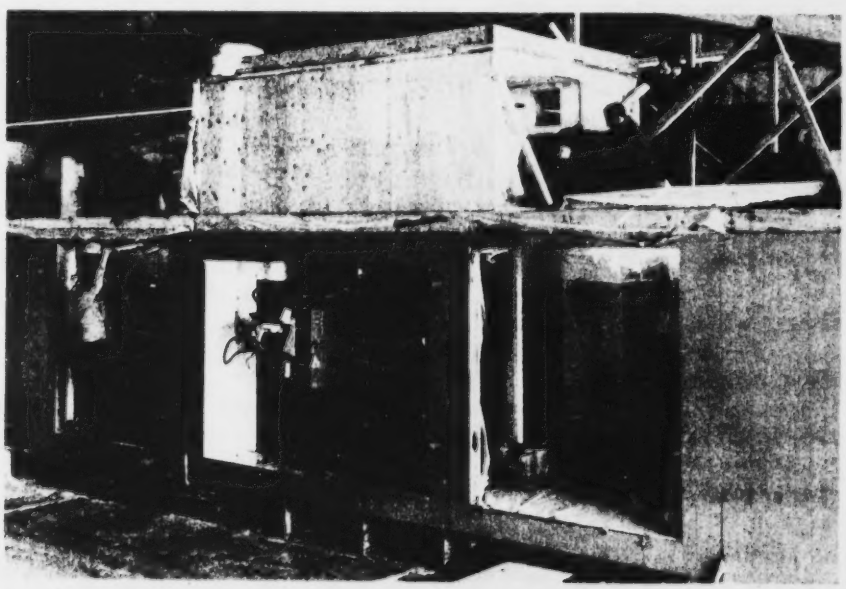


FIG-14 Building modules for Wainwright - The twelve building modules which comprise the Wainwright facility during assembly at Lacey, Washington.

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for home delivery of water and pickup of waste materials are loaded, unloaded, and maintained. Fuel storage tanks are located some distance from the structure for safety. Dikes and appropriate liners surround fuel tanks to prevent environmental damage in the event of tank rupture.

The modular units housing the Emmonak plant have dimensions of 9'x9'x38'. They were provided by Porta Kamp in Houston, Texas. The modules comprising the Wainwright installation measure 9'x9'x19'. They were built by Mobile Modules Northwest, Inc. at Lacey, Washington. Exterior walls, the roof, and the floor are appropriately insulated, and the structures are designed for seismic zone 1. Interfacing between modules is sealed so that with final assembly on site the facility appears to be a single integral structure.

At Wainwright, prebuilt trusses were used to provide a single roof over the entire assembly which also furnished additional unheated storage space (Fig. 15). The foundation for the Wainwright facility consists of drilled-in piling which was placed and "frozen back" into the permafrost prior to arrival of the modules on site.(5) This foundation is fully exposed to atmospheric temperatures to maintain the integrity of the permafrost.

At Emmonak, no additional roof over the assembled modules was provided (Fig. 16). Storage space was made available by on-site construction of a small, un-insulated shed. No permafrost was found to exist at Emmonak and bearing capacity of the soil was determined to be very low. Consequently, the foundation for this structure is composed of a timber mat upon which rests steel

FIG-15 Central Community Facility, Wainwright - Note vertical fuel tanks in the background.

FIG-16 Central Community Facility, Emmonak - Note drainage problems in the village during Spring.

framework to support the building. Skirting was provided to shield the soil beneath the building from the extreme winter cold and thereby reduce movement of the structure by frost heaving.(6)

The processes housed by the structures are water supply treatment, wastewater treatment, human waste disposal, household waste disposal, and heating. Personal sanitation facilities are toilets, lavatories, drinking fountains, laundry, showers and sauna bath (Fig. 17).

In order to reduce the operating costs, these several functions are integrated to recover reusable byproducts wherever possible, usually in the form of waste heat.

Utiliducts are used to provide water delivery and waste collection for the BIA school in each village. These are corrugated metal pipes with urethane foam insulation and plastic pipe liners to house the actual supply and return pipes and to protect them from the weather (Fig. 18). Heat traces are provided to permit warming of the utiliduct, if necessary, during severe cold conditions. Under normal conditions, pipes within the utiliduct are kept dry by vacuum or by air purging and are thereby protected from rupture by freezing. Sumps and tanks located in the BIA facility are used to hold the water or wastewater between periods of operation of the utiliduct.

Utiliducts are also used to house the intake and outfall lines for the central utility. Where possible, services to and from BIA are mutually contained.

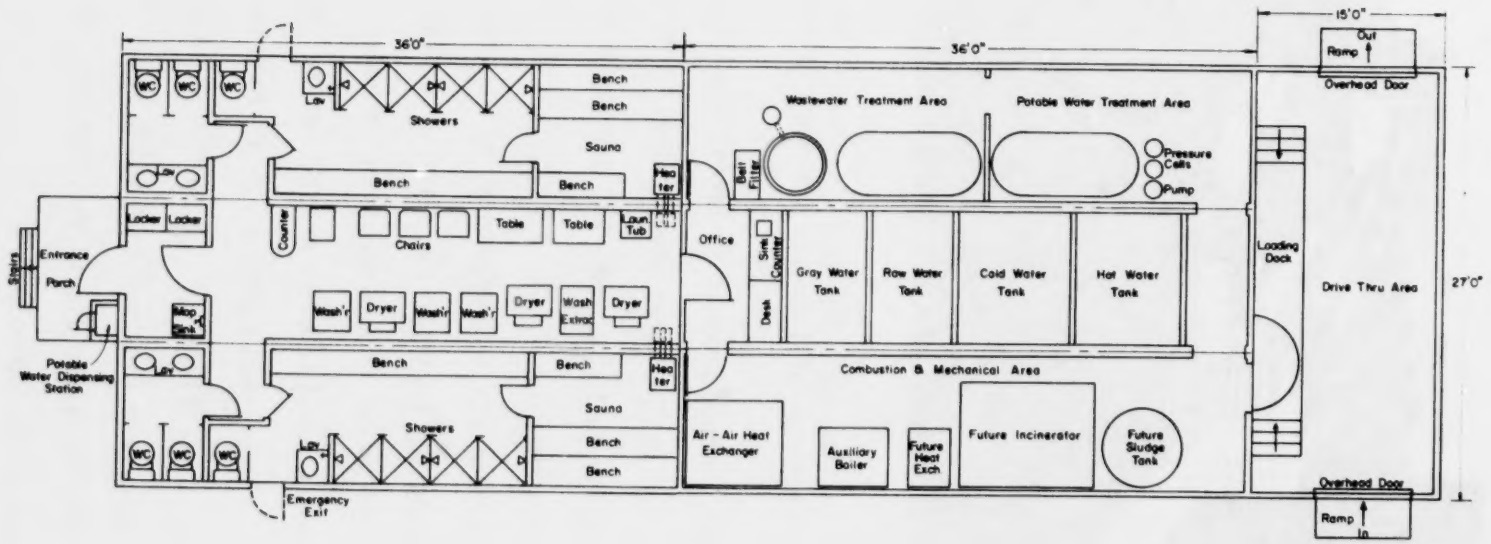

FIG-17 Floor Plan for Central Community Facility at Wainwright

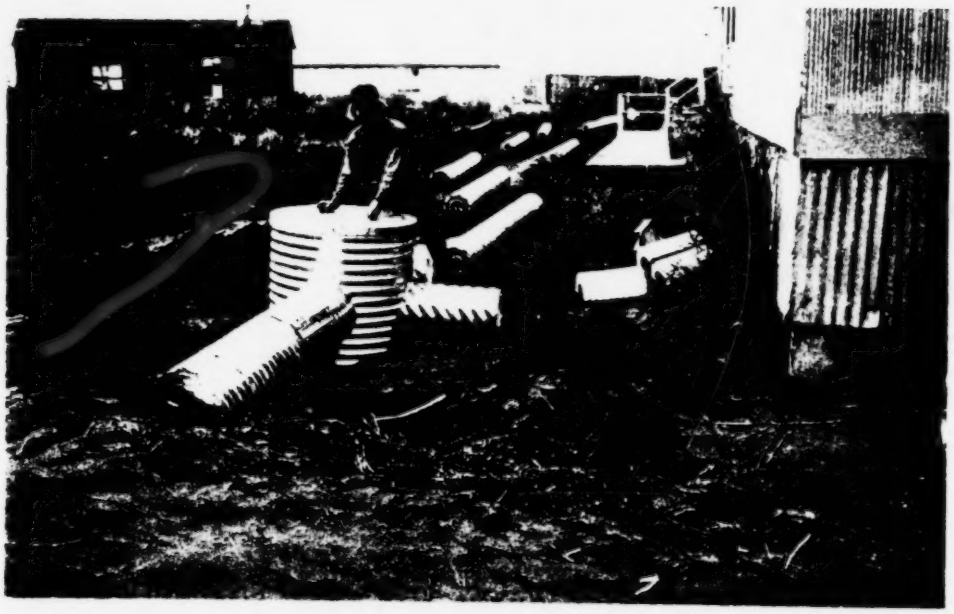

FIG-18 Utiliduct at Emmonak - The BIA School will tie into the Central Community Facility via the duct in summer 1973.

Water for the Emmonak project is taken from Kwiguk Pass, one of many sloughs forming the Yukon River Delta. This water is of fair sanitary quality during winter, but carries a heavy silt load during spring and summer runoff periods.

A water treatment plant manufactured by Keystone Engineering in Seattle, Washington, purifies the river water for use (Fig. 19). After tempering the water to a temperature of between 50^{o} and 60^{o}F, it is pumped through the treatment process which adds chemicals for coagulation of suspended matter which is then removed by sedimentation and sand filtration. Chlorine is added as a disinfectant. This equipment is sized to produce about 12,000 gallons per day of potable water for use in the facility, for delivery to homes, or for use at the school.

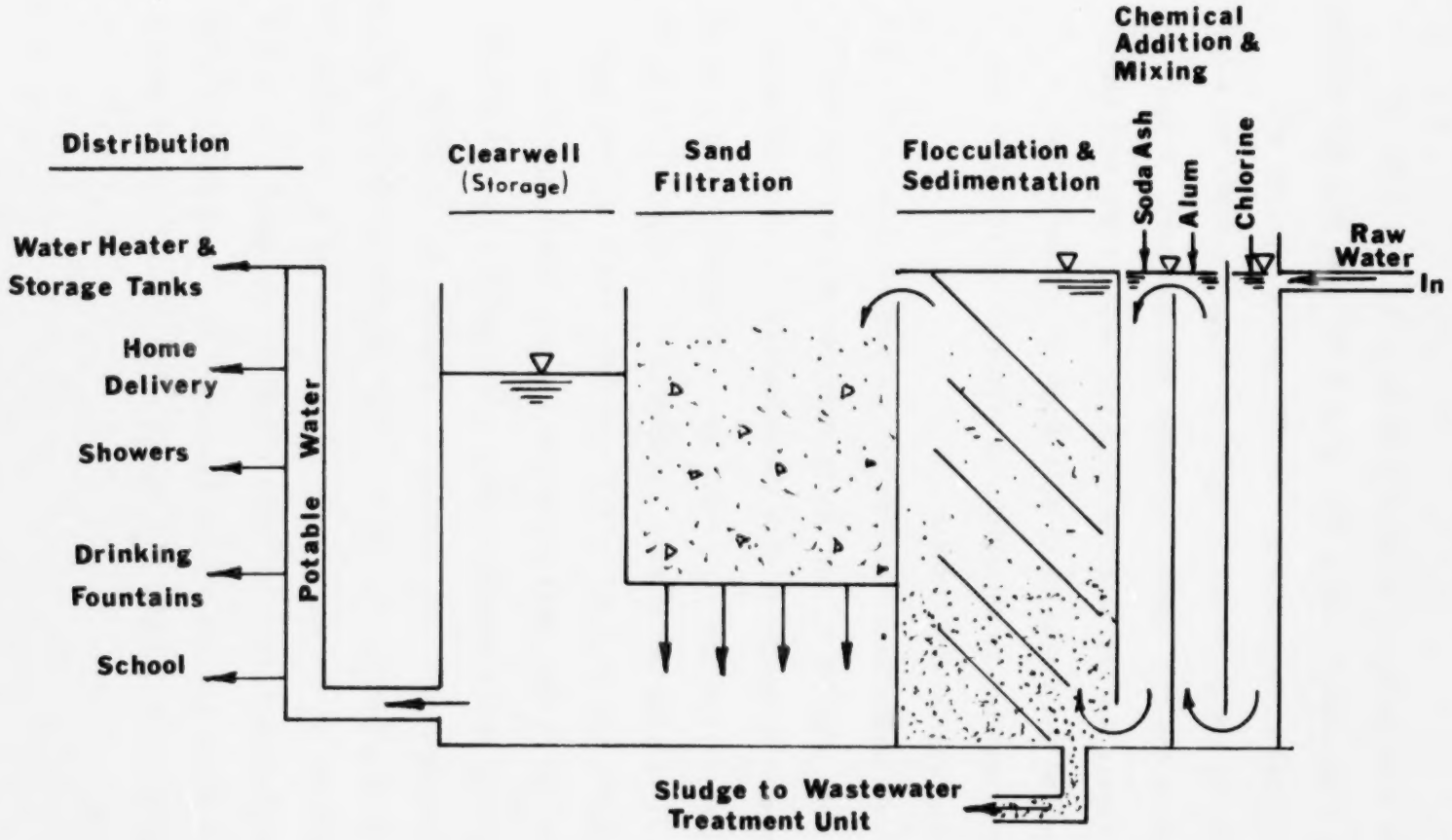

FIG-19 Typical Potable Water Treatment Plant (Schematic)

No river water is accessible at Wainwright so water is pumped from a small tundra lake about 9,000 feet from the village. An insulated storage tank of 1,000,000 gallon capacity was provided by the U. S. Public Health Service to contain the water throughout the cold season (September through June). A year-round supply was not feasible since the lakes in the area are all shallow and freeze up to full depth during the winter. Treatment applied at Wainwright is virtually identical to that described earlier for Emmonak.

Performance specifications for the water supply process were based upon population, per capita requirements, and available supply. In consultation with the communities, it was decided that five gallons per capita per day is an adequate supply in the homes if bathing and laundry are done at the village facility and if water is not used for toilet flushing. It was decided that five to ten gallons will provide an adequate shower and that individuals would probably shower twice weekly. The BIA school is expected to use large quantities of water. Allotment of 1000 gallons per day for the school at Wainwright and 1500 gallons per day for the Emmonak school can be summarized as 250 gallons per teacher per day. This amount includes the water used by all school facilities and not the teachers alone. Laundering equipment was provided on the basis of an estimated three loads per family per week.

Daily Water Requirements (gal./day)

APPLICATION	EMMONAK (500 Pop.) (Gallons)	WAINWRIGHT (375 Pop.) (Gallons)
Personal home use @ 5 gpcd*	2500	1875
Showers (2 showers/person @ 3 gpcd per week)	1500	1125
Laundry (2 loads laundry @ 1.5 gpcd per family/week)	750	565**
School (gal./day)	1500	1000
TOTAL	6250	4565

*gpcd - gallons per capita daily.
**565 gal./day is recycled shower and laundry water.

Potable water treatment specifications required that the product meet Public Health Service Drinking Water Standards.

To minimize water use and in keeping with the concept that it is simpler to treat wastes only than to treat wastes and water in mixture, low water use plumbing was specified throughout the projects. Showers employ flow-limiting devices and toilets reuse the flushing fluids up to one-hundred times. Human wastes collected from toilets in the facilities and the contents of "honey buckets" from the homes are incinerated.

Another water saving device is the sauna bath. Normally, people tend to use showers as a place to soak and to warm up. The sauna does not have this high water requirement and yet fulfills the same need (Fig. 20). Residents of Emmonak have been bathing in the kashim (an Eskimo equivalent of the sauna) for many years and recognize its value. At Wainwright, where this has not been the

FIG-20 Emmonak Villagers using sauna - Resting in the dressing room after a hot sauna. Entrance to the sauna is in the rear.

custom, people will be given instruction and encouragement in the use of the saunas in order to conserve water.

Backwash water from the water treatment process, shower water, and laundry water from the facility is collected in small sumps and pumped into a holding tank. From the holding tank, the wastewater is metered at a constant rate through a filtration device or centrifuge to remove large suspended particles and then passed into the treatment plant (Fig. 21).

Wastewater treatment at Wainwright was designed by Environmental Conditioners, Inc., of Vancouver, Washington. It consists of chemical coagulation using lime in an upflow clarifier to remove fine suspended materials and to coagulate and remove part of the dissolved waste. In order to neutralize the alkalizing

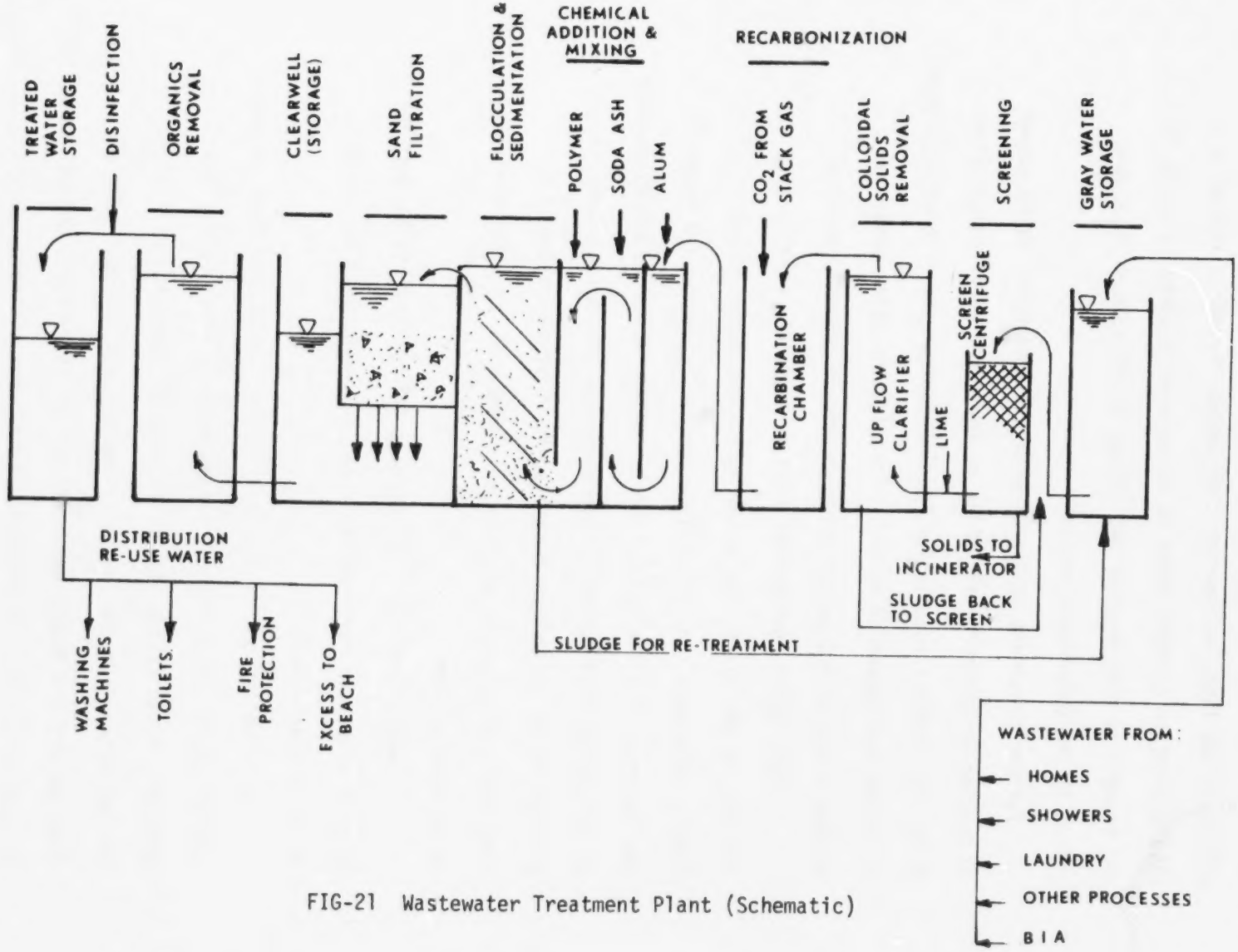

FIG-21 Wastewater Treatment Plant (Schematic)

effect of the lime, wastewater then passes through a redwood slat recarbonization chamber where it is exposed to carbon dioxide gas and brought to near neutral pH. These two treatment steps are unique to the Wainwright project.

Further treatment continues with the wastewater being pumped to another treatment unit similar to the water purification plant which, by chemical coagulation; sedimentation; and filtration, removes dissolved and suspended matter. Finally, the water passes through a bed of activated carbon to remove organic compounds.

At this point, wastewater from the Emmonak facility is returned to the river. At Wainwright where water in any form is so scarce, the treated wastewater is stored for reuse in the laundry. The treated wastewater which cannot be stored because of limited storage volume is discharged to the ocean beach. A portion of the wastewater must also be rejected routinely to keep dissolved organic and inorganic compounds in water for reuse at acceptable levels.

Wastewater treatment equipment equal in capacity to that for potable water was required since any discharge must be treated to State standards.

Solid wastes are of two basic types: human and other pathological wastes and household wastes such as paper, cans, and garbage. Human wastes within the central community facilities are collected from the low-water-use toilets and kept separate from laundry and shower wastewaters. At Wainwright, collection is done by vacuum. At Emmonak, it is accomplished by gravity.

These wastes are combined with the "honey bucket" wastes collected in vehicles from the residences and sludges from treatment plants. This material is then fed into the pathological incinerator for complete destruction (Fig. 22).

Trash collected from homes in Wainwright is put directly into the incinerator at the facility. This incinerator was built by Wasteco, Inc. Bottles and cans which are separated from other trash in the homes and ashes from the facility are transported to a disposal site.

Specification of solid waste disposal equipment was based upon anticipated loadings and the requirements to meet State emission standards. Loadings totaling 3 lb. per capita per day including human wastes were judged to approximate current conditions. Incinerators were sized to handle slightly larger loads.

Trash collected from the homes in Emmonak will be compacted and incinerated utilizing a BURN-ZOL Incinerator with heat recovery equipment. The human wastes will be mascerated and then dewatered utilizing a centrifuge. The solids will then be incinerated and the remaining liquid portion will be given physical/chemical treatment as described previously.

Energy conservation is the key which locks the several processes into an integrated system for it is energy, fuel, or heat that is of primary economic concern. The cold climate requires that the water be heated to prevent freezing.

Fuel is required for both heating and incineration. Heating is required for water tempering for optimum treatment, water

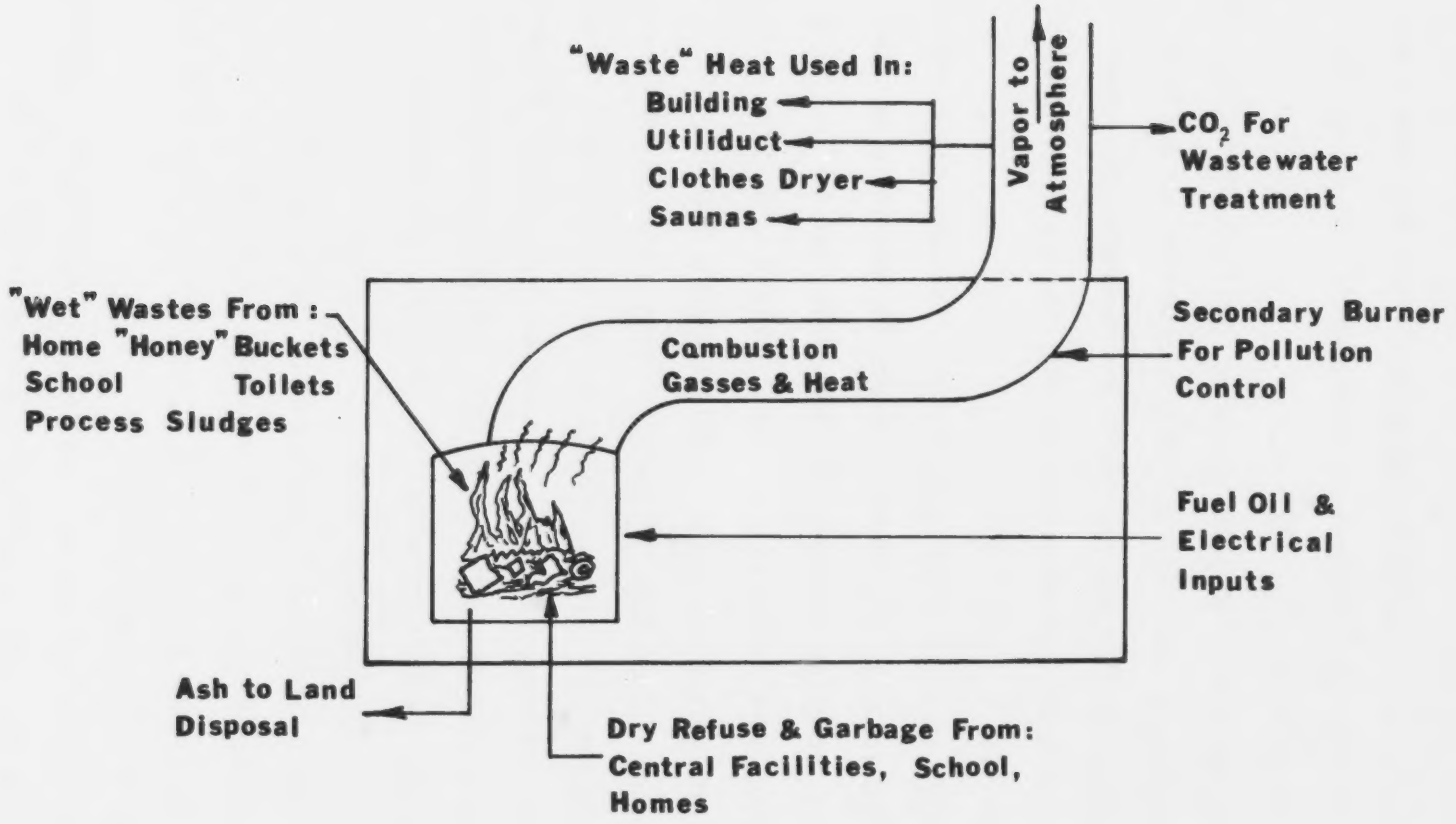

FIG-22 Schematic of Incinerator Process

heating for showers and laundry, clothes dryers, sauna baths, and space heat.

In order to reduce the apparent extravagance of incineration, heat exchangers were designed into the equipment. The heat exchangers were integrated in such a way that the incinerator can normally provide heating requirements. Only at times of extreme cold or no waste load is the auxiliary heating equipment needed.

The recarbonation chamber of the Wainwright wastewater treatment plant draws flue gas from the incinerator as a source of carbon dioxide and thus provides further integration. "Waste" heat from the incinerator is used in the clothes dryers and saunas. A special-purpose oil, circulated through heat exchangers, is the heat transfer medium in the facility.

SECTION V

OPERATION OF FACILITIES

The Emmonak plant became partially operational in November 1972. It is providing potable water, laundering and bathing service, and treatment of wastewaters. The facility is receiving heavy use, especially the saunas. The human waste and treatment sludge disposal component of the Emmonak facility remains to be installed.

In December 1972, it was discovered that the hot water storage tank was defective. This resulted in rusty water output. An interim solution was provided by installing a rust filter in the hot water line. During the 1973 construction season, all tanks will be glass lined to prevent further occurrence of this type of problem. On two occasions, power failures caused the river intake and part of the utiliduct to freeze up. The system was made operational again within a few days of each power failure.

Delay associated with transportation of the modular components and equipment to Wainwright resulted in a later opening of that facility to the public. Official opening of the facility occurred in February 1973.

Except for distribution of water and collection and disposal of wastes produced in homes, the Wainwright facility performs all planned functions. The USPHS expects to make the tracked vehicles available for use in waste collection and water distribution during the summer of 1973. Also, arrangements have been made whereby the

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Alaska State Housing Authority will install circulating toilets and waste and water-holding tanks in 25 recently completed village homes.

Within the Wainwright facility, the wastewater treatment/recycle components are clearly the most complex and vulnerable sub-system of the facility. It was quickly learned that under hard use certain components such as pumps and solids removal equipment have certain idiosyncrasies that must be respected. Automatic controls also proved to require regular attention in order to avoid temporary malfunction.

The lack of reliable power systems in both villages can be singled out as the one factor having an adverse effect on continuity of operation. At Wainwright, where the city power system is rather makeshift, AVDP has provided an alternative source at considerable cost. In the interest of economy and reliability, future projects of this nature should consider self-contained power supplies.

Another very important consideration in both of these projects has been the absence of a satisfactory communication system. Radio and telephone contact with the villages under the existing systems is dominated by atmospheric and climatologic phenomena which frequently interrupt communication for extended periods of time. Although the operators are fairly well prepared for routine operation of their facilities, there have been numerous occasions on which communication with other project personnel has been imperative but impossible.

SECTION VI

EVALUATION OF FACILITIES

The two partially completed installations are in the process of final systems shakedown and startup operations. The project staff, at this time, has only an intuitive understanding of the strengths and weaknesses of the installations and the component systems. A discussion of these, at this time, would be too speculative to be included in this report.

Process monitoring has begun. Data is being accumulated on facility use, energy input, efficiencies, etc. EPA will present a full analysis of such information and a comprehensive evaluation of the suitability of the demonstration facilities in serving their intended purpose after one year of full operation. The following list of items to be monitored is typical of the type of data which will be collected and analyzed for the AVDP facilities:

I. Fuel Consumption
   - A. Auxiliary Boiler
   - B. Incinerator
     1. Secondary
     2. Waste Primary
     3. Sludge Primary
   - C. Electric Generators
     1. 50-KW
     2. 12-KW

II. Water (Potable)
   - A. Monthly Quality Analysis
   - B. Volumes Used
     1. Home Delivery
     2. Showers (in plant)
     3. BIA
   - C. Materials Used

III. Water (Recycle)
   - A. Monthly Quality Analysis
   - B. Volumes

1. Laundry
2. To Beach

C. Materials Used

IV. Electric Consumption
- A. Heating - Aux. Boiler & Circulation Pump
- B. Incineration
- C. Water Treatment
- D. Wastewater Treatment
- E. Total Output of Generators

V. Graywater In
- A. Homes (from Vehicles)
- B. Laundry
- C. BIA

VI. Human Waste Processed
- A. BIA
- B. Facility
- C. Homes
- D. Total

VII. Temperature Records
- A. Outside - continuous
- B. In Large Water Tank - continuous
- C. In utiliduct
  1. At "Y" Branch
  2. At BIA
  3. At AVDP
  4. At Outfall

VIII. Operator Time
- A. Maintenance
- B. Operation
- C. Vehicles

IX. Vehicle Records
- A. Fuel - each vehicle or trailer
- B. Hours of operation - each unit
- C. Maintenance
  1. Time
  2. Cost

X. Income
- A. Laundry
- B. Showers
- C. Saunas
- D. Home
  1. Water
  2. Wastewater

3. Solid Waste
4. Human Waste

E. BIA
1. Water
2. Wastewater
3. Human Waste
4. Solid Waste

F. Subsidy
1. EPA
2. PHS
3. BIA
4. Other

XI. Expenses
A. Salaries, wages, etc.
B. Fuel
1. Vehicles
2. Project
C. Supplies and Materials

XII. Fire System
A. Record of incidents
B. Materials Used

FIG-23 Saunas at Emmonak - At Emmonak, saunas are in higher demand than showers. The village council charges $1.00 per bath. Proceeds from saunas, showers, washers, dryers, and water sales are used to pay attendants and to meet incidental operating expenses.

Recipient Appraisal

Villagers' attitude towards the community utilities center concept, especially to the water supply; bathing; and laundering aspects, has been highly positive (Fig. 23). Local appraisal of the recently completed installations, however, is in understandably tentative terms. Service has been partial and intermittent thus far. Local attitude, therefore, remains largely one of positive anticipation.

At both locations, the need for safe water is more strongly felt than the requirement for safe methods of human waste disposal.

At Emmonak, the saunas and dryers are in high demand. In January, a power failure resulted in the freeze-up of the water intake. The City Council mustered 160 hours of volunteer labor to make the plant operational again. This kind of involvement reflects the villagers' attitude and commitment.

At Wainwright, reservations have been raised about the practicality of a vehicular water distribution and waste collection system on bare tundra. Until village streets are further improved, vehicular service there may have to be suspended during the short summer.

Village leaders have expressed concern that the operating and maintenance (O&M) costs for the plants will substantially exceed local resources. Investigations of this problem by EPA staff indicate that this concern is justified and requires major decisions on ownership and responsibility for covering O&M costs for the foreseeable future.

Project Costs

Under Section 113(d) of P.L. 92-500, "There is authorized to be appropriated not to exceed $2,000,000 to carry out this section." The original legislation (Section 20, P.L. 91-224) "authorized to be appropriated not to exceed $1,000,000."

Of the original $1,000,000, $600,000 was appropriated in Fiscal Year 1971 and the remaining $400,000 was appropriated in Fiscal Year 1972. These funds were utilized for the facility design and construction contracts. It is anticipated that about $250,000 will be utilized for the design and construction of the third project during Fiscal Year 1974.

Project costs escalated during development and construction due to delays, inflated material and equipment costs, increased labor costs, etc. Each increase was examined carefully and was determined necessary. It is now felt that project concept and costs are compatible.

Final costs must await EPA acceptance and the final audit. Current contract costs as of May 1, 1973 are as follows:

Wainwright		
Initial Design		52,919
Final Design and Construction		508,550
	TOTAL	$561,469
Emmonak		
Initial Design		63,722
Final Design and Construction		514,332
	TOTAL	$578,054
Third Design		
Initial Design		60,223
	TOTAL AVDP	$1,199,756

It is very important to recognize that the demonstration projects are totally EPA facilities and as such must be supported 100% by EPA and not by the villages. Operation and evaluation of these demonstration projects is an enormous job. Without the full-scale demonstration, new or improved technology would never have advanced to the point where the villages themselves and other government agencies can implement an operational program.

Congress should recognize that the cost of the demonstration program is necessarily greater than an actual "production-type" program because of the planning, design, and evaluation costs associated with experimental facilities. It is also to be recognized that inflation of materials, labor, and services could offset the development costs resulting in the "production-type" projects to cost approximately the same as the demonstration projects.

The "Third Design" project should also give a better overall estimate of the economic impact, since its design village size of 75-125 population represents the size of approximately one-half of the native villages.

At this time, the facilities have not been fully "shaken-down" nor has there been time to evaluate the technical operation or operating costs. A discussion of these aspects will be included in a progress report available by July 1, 1974.

Institutional Considerations

An appropriate institutional framework for the planning, construction, operation, and maintenance of small utility systems in rural Alaska does not exist. Whereas communities are generally expected to be self-sufficient in this regard, Alaskan villages are too small; too isolated from centers of supply; and too devoid of economic base to be able to manage any but the most makeshift utilities on their own.(7) The long-term viability of bonafide utility systems in Alaska villages, therefore, will depend on the establishment of mechanisms at the state-wide or regional level to provide support services.(8)

The precedents for this exist. An REA supported Alaska Village Electric Cooperative attempts to meet the need for operating support in reference to power systems. The Bureau of Indian Affairs and the Alaska State Operated School System share fiscal responsibility for village schools. The Indian Health Service provides medical care. In relation to water supply and waste disposal, neither the legal authority nor the financial resources for an operation support mechanism appear to exist.

Enactment of the Village Safe Water Act (AS46.07.010-080) by the Alaska State Legislature in 1970 and passage of a three million dollar bond issue for the construction of village water and waste processing facilities constitute initial efforts on the part of the State in reference to village utilities. Implementation of the Act has been delayed because of the lack of resources for its administration.

In March 1972 partly as a result of close liaison between Alaska Village Demonstration Project staff and the Alaska Department of Environmental Conservation, an amended version of the Village Safe Water Act was introduced in the State legislature as HB.719. It was not enacted in 1972, nor was it reintroduced in 1973. It would have authorized the Alaska Commissioner of Environmental Conservation to play a direct role in all phases of rural water and waste utility service administration. It would have constituted a significant first step towards the creation of the necessary supportive mechanisms.

Concern at the State agency level over the problem of how to provide appropriate service and to meet increasingly strict environmental protection standards is currently high. In late 1972, the Governor's Environmental Advisory Board recommended that the State Commissioner of Environmental Conservation prepare a staff paper to define the specific problems in water supply and sewage disposal systems in Alaska and then recommend a series of actions to solve these problems. At the invitation of the Commissioner, a group of 23 key representatives of Federal and State agencies, including AVDP staff, addressed themselves to these issues in a two-day seminar. The participants easily identified the problems. A wide range of opinions emerged on how they should be solved. The findings of the conferees are being summarized in a Department of Environmental Conservation Research Report and will be presented to the Governor's Environmental Advisory Board in the near future.

The potential for the formation of regional inter-village support organizations also exists. One alternative is through the formation of additional boroughs roughly equivalent to a county in the lower 48 states, and subsequent transfer of powers related to utilities from all member municipalities to the borough. With the exception of the communities on the North Slope, this does not appear to be an immediate prospect. Aspirants to boroughship must demonstrate financial responsibility and then face strong, legal challenges from groups representing the potential tax base.

Wainwright is one of five member cities of the recently-created North Slope Borough. At the time of reporting, the formation of this borough is still being contested by oil interests. If the borough can manage to establish itself firmly and if it succeeds in collecting taxes at proposed rates, then the fiscal resources may be available to support operation and maintenance of the Wainwright Central Community Facility and of plants similar to it in all five member villages. The oil discoveries on the North Slope, however, make the situation there unique. There is little foreseeable prospect that such boroughs can be formed in other predominantly rural areas.

A second alternative is for the Alaska State Legislature to exercise its discretionary power, under the State Constitution,(9) of establishing service areas within the unorganized borough to provide the institutional framework required. Within such a service area, transfer of powers to the legislature from villages which are

already incorporated would seem no more of a problem than in the case of such a transfer to the borough assembly in the organized boroughs.

The unorganized borough is essentially an instrumentality of the State over which the State legislature has the powers of government which the borough assemblies exercise in the organized boroughs. To date, the State legislature has chosen not to act in reference to the unorganized borough. In effect, the areas in respect to "local powers" have not been governed.

A third alternative is to authorize and encourage regional native Corporations (required by the Alaska Native Land Claims Settlement Act) to assume responsibility for utility services by utilizing proceeds from the Claims Act to subsidize utilities operation. Potential adverse affects of this alternative should be carefully considered.

Since the native regional corporations are responsible to their native stockholders only, their control over rural utilities could lead to further polarization of natives and non-natives in the bush. Encouragement leading to dispersal of proceeds from the Alaska Native Claims Settlement Act to provide services, instead of their investment in interest or profit-earning enterprise, is considered by many to be fiscally unsound counsel.

Settlement benefits could be dissipated rapidly if they were applied toward meeting substantial service needs. Assuming a final Alaska Native enrollment of 75,000 persons, a total benefit

consumption policy would result in an average annual per capita income of $640 for a period of 20 years. A constant pay out investment model could be expected to yield $560 per person each year in perpetuity.(10)

In consideration of the very low level of economic development in the bush, competing demands for this or some intermediate yield will be tremendous. Skillful fiscal management and management of the lands which are part of the settlement may increase the total resources available to some regional corporations. These resources could serve as "seed", leading towards development of a firmer economic base.

It should be noted that the Canadian Territorial Governments are providing community water and sanitation services in the Yukon and Northwest Territories. A review of Canadian reports indicates that the Territorial Governments are assuming primary responsibility for provision of such services in both tax-based and unorganized communities. The Government of the Northwest Territories has gone much further in defining service standards than the Federal or State governments have in the United States. With anti-pollution requirements less stringent in Canada, provision of waste treatment facilities has been given less emphasis there.

A recent document of the Department of Local Government, Government of the Northwest Territories, reviews the history of water and sanitation policy for small communities in the Canadian North and proposes broad revisions.(11)

In the final analysis, it is not overly important who actually owns the facilities. The real question centers on the locus of responsibility for providing operating and maintenance resources. Unfavorable native reaction to the externally owned and controlled institutions such as the BIA schools, State-operated schools, and Native Service Hospitals suggests that the owner should be the village. This conclusion is only valid in conjunction with a reliable financial plan for operation. The long-term goal, therefore, will be to implement a viable program of O&M and to transfer ownership to the municipalities.

Environmental Impact

The AVDP program includes demonstration of the acceptable technology and the development of recommendations for a statewide plan. Therefore, both aspects of the AVDP program on environmental quality will be delineated during the remainder of the program.

SECTION VII

FUTURE DEVELOPMENT

Additional Project Design

Interest for this program has been high throughout the planning and construction phases. As a result of discussions with members of Congress, the need for projects demonstrating facilities for much smaller villages became apparent. Consequently, a third design contract was negotiated with Stefano & Associates of Anchorage, Alaska, from among the six originally qualified proposers.

This project will utilize many of the developments and features from the first two; and, in addition, would take full advantage of system integration for energy savings. This project will be coordinated with the Department of Housing and Urban Development Modular Sized Integrated Utility System Program. The project will use waste energy from electrical power generation to heat the entire facility. In addition, potable water and wastewater will be treated by a unique evaporative process with some reuse of water in non-potable functions. Further efficiencies in pre-fabricated module use are expected.

Integration of Small Utility Systems

Literature of public health and environmental engineering fields relating to the Arctic and sub-Arctic contains numerous arguments for providing adequate central power, communication, water supply, waste disposal, improved housing, and the like, as

prerequisites to improving health among residents of remote northern communities. Attempts to provide these requirements have typically been based upon direct application of conventional temperate climate technology to the arctic with the reinforcement of large sums of money. In spite of numerous attempts to provide these services, successful projects are far outnumbered by failures or partial failures even in relatively wealthy communities such as Fairbanks and Anchorage.

Abandonment of obviously inadequate technology is indicated as a first step in accelerating progress in far northern communities. Non-conventional processes are available for application which have previously been used in isolated and unusual cases. Indications are that the non-conventional approach stands a better chance of success in Northern Alaska.

The Department of Housing and Urban Development has initiated a study of Modular Integrated Utility Systems (MIUS) which would have broad application. Long range implications are that such systems can be applicable nationwide.

Unit processes have inherent limitations or efficiencies which dominate their acceptability and applicability. Skillful integration of unit processes into a single system has the effect of increasing the efficiency of each sub-system. For example, when electricity is generated for a remote community in Alaska by diesel generators (efficiency about 40%) power costs are about 15¢ to 20¢ per KWHr. Home heating plants range in efficiency between

70% and 85%. If power generation and home heating are integrated, system efficiency may approach 95%. This could be done by salvaging the heat by-product of electric generation for use in home heating. This is an oversimplification of the MIUS concept, but the example is valid, as the integrated system is more efficient than both of the sub-systems.

When the MIUS approach is used on a total utility scale for any given community, services are possible which otherwise would be unobtainable. It is simpler and more efficient to control pollution from a single source than it is from a number of smaller sources.

By employing non-conventional sub-systems in the MIUS approach, other advantages may be realized. For example, conventional waste treatment is based upon water carried sewage which can be effectively treated for removal of pollutants, but at very high cost. Non-conventional sub-systems such as demonstrated in AVDP not only use very little water, but wastes are treated in such a way as to totally prevent water pollution and simultaneously recover some of the thermal energy released in their destruction. Moreover, the expense of conduits for transmission of large quantities of water and wastewater is greatly reduced by lowering water usages.

MIUS should be developed to take maximum advantage of local resources while simultaneously conserving natural resources. An example of this would be the use of coal as the primary energy source where it is locally available (e.g. Wainwright). In some

locations this would have the additional beneficial result of strengthening the local economy.

MIUS has great potential for application, but nowhere does it seem more applicable than in the far north. The economies it promises may be the single most important factor in providing needed environmental health and environmental protection services which have previously failed.

Future Activities

The goal of AVDP is to develop and demonstrate the technology necessary for providing central community utility facilities for the native villages. The "systems" approach will be extensively employed in optimizing energy investment in facility operation. Based upon demonstrated technology, recommendations for a statewide program shall be submitted to Congress. Close coordination with the State of Alaska will be required before any recommendations are made.

Evaluation including operation and maintenance of the facilities at Wainwright and Emmonak will continue for approximately one year with the goal of turning the facility over to the villages. Hopefully, the facilities can be maintained by EPA until they can be turned over to a responsible governmental body.

Prior to construction of a facility based on the third design, a village will be selected and residents will be asked to participate in review and finalization. A construction contract will be awarded for the third central community facility. Native operators

will be trained. This facility will be built and a one year evaluation will be conducted. Implementation of this third design facility is very important to successful compliance with the Act requirements.

The only alternate strategy which has been suggested would transfer the entire program to either the State of Alaska or to the HEW-PHS-Indian Health Service (IHS) for implementation. This alternate is not considered feasible since EPA has the legislative mandate to conduct this program. Further, neither the State of Alaska nor IHS is equipped to conduct evaluation studies as presently envisioned. Continued and expanded cooperation through Interagency Agreements will be utilized by EPA to successfully complete this program.

EPA will continue work on alternative approaches to develop a statewide program in conjunction with State and other Federal agencies while completing the optimization of the central community facilities.

This work will require the development of the costs and benefits associated with a statewide program including consideration of alternative means of financing the capital and operating costs of these facilities.

No special technical problems need resolution at this time. It should be emphasized that these are demonstration projects; and, as such, technical problems are to be expected and must be solved. Integration of the existing technology, under extreme climatic conditions, is the principal challenge of this program.

EPA will continue to coordinate this program with the State of Alaska, the Indian Health Service, the Bureau of Indian Affairs, and the local native villages and regional corporations. Discussions with Congress will be needed to formulate the future direction of the program.

This program will be coordinated with the Department of Housing and Urban Development, Office of Policy and Research. It is anticipated that our AVDP program can provide spinoff of technology into the HUD Modular Integrated Utilities Systems (MIUS) program. The mechanism for conducting additional work related to the EPA/HUD Memorandum of Understanding (MOU) for MIUS is the preparation of individual supplements to the basic MOU. Specifically, Supplement Number Two has been consummated to obtain financial and technical assistance for consideration of MIUS concepts in the third project.

SECTION VIII

REFERENCES

1. Federal Field Committee for Development Planning in Alaska; Alaska Natives and the Land; Anchorage, Alaska; October 1968, p. 19.

2. ibid. p. 12.

3. All population data is derived from Federal Field Committee for Development Planning in Alaska, Villages in Alaska and Other Places having a Native Population of 25 or More, Estimates, 1967, Anchorage, 1967.

4. Report of the National Academy of Sciences on the AVDP.

5. Permafrost is defined as any perennially frozen material. Composition ranges from nearly pure ice to bedrock. At Wainwright, permafrost is the earth layer from a depth of 18" below the surface downward to a distance estimated at about 1000 feet. Making up this permafrost is a combination of uncompacted silt with a small amount of sand, gravel, and ice.

6. Frost heaving is a phenomenon which occurs when soil of high moisture content freezes. When the water in the void spaces expands, it causes the surface of the ground to be thrust upward. Conversely, contraction cracks are sometimes formed.

7. An Investigation of Social and Economic Implications of The Alaska Village Demonstration Projects, Arctic Environmental Research Laboratory, EPA, March 1973.

8. A recent comprehensive study commissioned by the Alaska Governor's Office of Planning and Research and funded by the Farmers Home Administration arrives at a similar conclusion. See: Initial Plan and Program: Water Supply and Waste Disposal, Planning Area V -- State of Alaska, Office of the Governor, Dec. 1972, pp. 7-8.

9. Alaska State Constitution, Article X, Section 6. See also Alaska Statutes, Sec. 29.03.020.

10. Computed from models developed by Robert R. Nathan Associates, Inc., in Implementing the Alaska Native Claims Settlement Act, Washington, D. C., April 1972.

11. Proposed Water Sanitation Policy for Communities in the Northwest Territories, Department of Local Government, Government of the Northwest Territories, March 1973.